



WT8043

Synchronous Signal discriminator
for Multi-Sync Display Monitor

Jan. 30, 1996

Description

The WT8043 is a silicon monolithic circuit designed for synchronous signal processing of multi-sync display monitors capable of coping with many kinds of PC's and workstations. It can be applied to display monitors supporting standard IBM VGA, VESA super VGA and IBM 8514/A video modes. It can also be used in other high-end display monitors supporting non-standard video modes with user-defined horizontal/vertical frequency ranges.

WT8043 incorporates many functional circuits, horizontal/vertical frequency discrimination, display mode selection, and synchronous pulse polarity detection, into a single chip. Therefore, by using WT8043, monitor makers can shrink the PC board size, reduce the material cost with fewer components, and reduce labor cost as well.

Features

- Accepting separate H&V Synchronous signals with any polarities
- Support VESA VGA (640x480, 640x400, 640x350), VESA SVGA (800x600), European SVGA (800x600), VESA new SVGA (800x600), XGA (1024x768) and 1280x1024.
- Also including NEC (24K) mode, 3 VESA New 75Hz timing modes and Apple MAC II (35k) mode.
- Capable of processing horizontal frequency from 25KHz to 80KHz
- Capable of processing vertical frequency from 50Hz to 120Hz
- Standard IBM video mode control outputs (1024x768, 640x480, 640x400, 640x350)
- Six non-standard horizontal frequency control outputs with predefined frequency range. (users can define their own horizontal frequency range)
- Fixed polarity horizontal and vertical synchronous signals output
- Power supply voltage: 5V, but mode select control output and frequency discrimination control output, these open collector outputs can be combined with pull high resistor, pull up to 12V.

Application

- Auto size control for Multi-Sync Display Monitors

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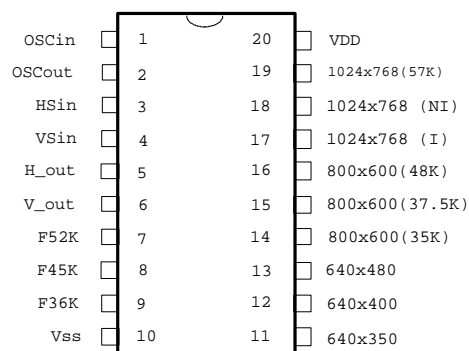
2F., No. 24, Industry E. 9th Rd.
Science-Based Industrial Park
Hsin-Chu, Taiwan, R.O.C.
Tel: 886-35-780241
Fax: 886-35-770419

Ordering Information

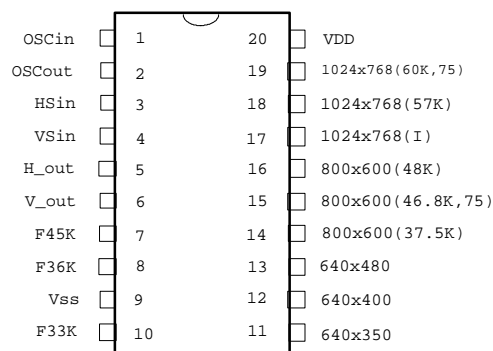
| Part No. | WT8043N16 | WT8043N20P1 | WT8043N20P4 | WT8043N20P7 | WT8043N20P8 | WT8043N24 |
|----------|-----------|-------------|-------------|-------------|-------------|----------------------------|
| Package | P-DIP 16L | P-DIP 20L | P-DIP 20L | P-DIP 20L | P-DIP 20L | P-DIP 24L (skinny type) |

Pin Configuration

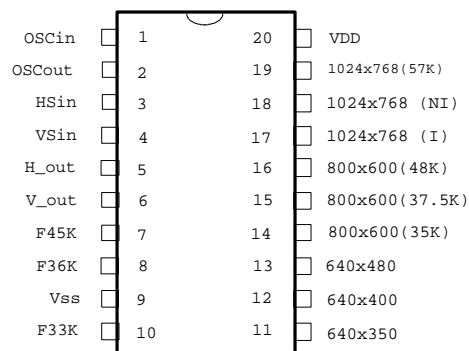
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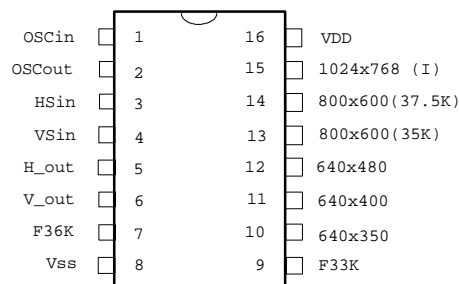
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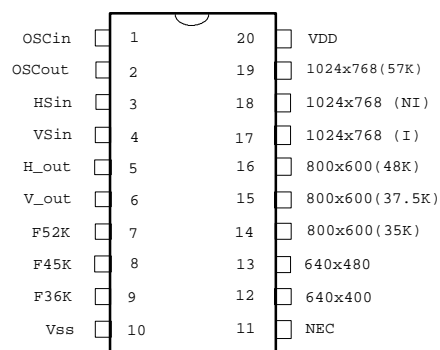
WT8043N20P4



WT8043N16



WT8043N20P7



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WT8043N24

| | | | |
|--------------------|----|----|-----------------|
| OSCin | 1 | 24 | VDD |
| OS Cout | 2 | 23 | F72K |
| HSin | 3 | 22 | 1024x768 (57K) |
| VSin | 4 | 21 | 1024x768 (NI) |
| H_out | 5 | 20 | 1024x768 (I) |
| 1280x1024 (64k) | 6 | 19 | 800x600 (48K) |
| V_out | 7 | 18 | 800x600 (37.5K) |
| F60K | 8 | 17 | 800x600 (35K) |
| F52K | 9 | 16 | 640x480 |
| F45K | 10 | 15 | 640x400 |
| F36K | 11 | 14 | 640x350 |
| Vss | 12 | 13 | F33K |

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Absolute Maximum Ratings

| Item | Symbol | Value | Unit |
|--------------------------------|-----------|-----------------|------|
| Digital Supply Voltage | V_{DD} | 5.5 | V |
| Horizontal Sync. Input Voltage | V_{HS} | $V_{DD}(5)+0.3$ | V |
| Vertical Sync. Input Voltage | V_{VS} | $V_{DD}(5)+0.3$ | V |
| Power Dissipation | P_D | 300 | mW |
| Operating Temperature Range | T_{OPT} | 0~70 | °C |
| Storage Temperature Range | T_{STG} | -40~125 | °C |

Recommended Operating Conditions

| Item | Symbol | Min. | Typ. | Max. | Unit |
|--|--------------|--------|------|--------|------|
| Digital Supply Voltage | $V_{DD} (5)$ | 4.5 | 5 | 5.5 | V |
| Supply Current (Oscillator on) | I_P | | | | mA |
| Synchronous Input Voltage Low | V_{IL} | | | 0.8 | V |
| Synchronous Input Voltage High | V_{IH} | 2.4 | 4 | 5.0 | V |
| Horizontal Synchronous Frequency Range | F_H | 25 | - | 80 | KHz |
| Vertical Synchronous Frequency Range | F_V | 50 | - | 120 | Hz |
| Crystal Clock Frequency | F_{CLK} | 3.5764 | 3.58 | 3.5836 | MHz |
| Open Drain Pull High Voltage | V_{OH} | | 8 | 12 | V |

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Electrical Characteristics

($V_{DD}=5V$, $T_{OPT}=25^{\circ}C$, Crystal=3.58MHz)

| Item | Symbol | Min. | Typ. | Max. | Unit |
|--|---------------|-------|------|-------|---------|
| Discrimintaion of H. Synchronous Frequency | F33K | 32.95 | - | 33.05 | KHz |
| | F36.2K | 36.15 | - | 36.25 | KHz |
| | F45K | 44.95 | - | 45.05 | KHz |
| | F52K | 51.95 | - | 52.05 | KHz |
| | F62K | 61.95 | - | 62.05 | KHz |
| | F72K | 71.95 | - | 72.05 | KHz |
| Output Low (H-out, V-out) When $I_{OL} = 4mA$ | V_{OL1} | | | 0.4 | V |
| Output High (H-out, V-out) When $I_{OH} = -400\mu A$ | V_{OH1} | 2.4 | | | V |
| Open Collector Output Low When $I_{OL} = 6mA$ | V_{OL2} | | | 0.4 | V |
| Output Sink Current (H-out, V-out) When $V_{OL1} = 0.4V$ | I_{OL1} | | | 4 | mA |
| Output Drive Current (H-out, V-out) When $V_{OH1} = 2.4V$ | I_{OH1} | | | 400 | μA |
| Open Drain Sink Current When $V_{OL2} = 0.4V$ | I_{OL2} | | | 6 | mA |
| Input H_SYNC Pulse Width | W_{H_SYNC} | 0.56 | | 4 | μS |
| Input V_SYNC Pulse Width | W_{V_SYNC} | 0.56 | | 833 | μS |
| H_SYNC, Output Pulse delay, respect to Hsin | T_{DHS} | | | 60 | nS |
| V_SYNC, Output Pulse delay, respect to Vsin | T_{VHS} | | | 60 | nS |
| Upper Trigger Input Point (H_IN, V_IN) | V_{UTP} | 2.0 | | | V |
| Lower Trigger Input Point (H_IN, V_IN) | V_{LTP} | | | 0.8 | V |
| Noise Margin (H_IN, V_IN) | V_{NM} | | | 1.75 | V |

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Application Information

| Name | Function | Structure of Terminal |
|-------------|---|-----------------------|
| OSCin | A clock generating circuit is built into the chip. So if a resonator is connected to OSCin / OSCout, a clock signal can be obtained | I |
| OSCout | Referent to OSCin pin | |
| HSin | Input terminal of horizontal synchronous Signal | I, TTL Compatible |
| VSin | Input terminal of vertical synchronous Signal | I, TTL Compatible |
| H_out | Output pin, active low, fixed polarity of original H_sync signal w/ same pulse width | O, TTL Compatible |
| 1280 x 1024 | 1280x1024 mode control output | O, open drain |
| V_OUT | Output pin, active low, fixed polarity of original V_sync signal w/ same pulse width | O, TTL Compatible |
| F60K | H, frequency input 60k discrimination > 60k then active low, < 60k then high | O, open drain |
| F52K | > 52k then active low, < 52k then high | O, open drain |
| F45K | > 45k then active low, < 45k then high | O, open drain |
| F36K | > 36k then active low, < 36k then high | O, open drain |
| Vss | Ground | |
| F33K | > 33k then active low, < 33k then high | O, open drain |
| 640 x 350 | Mode select control output, if IBM VGA 640x350 mode, or VESA VGA 640x350 mode, then active low, else high state output | O, open drain |

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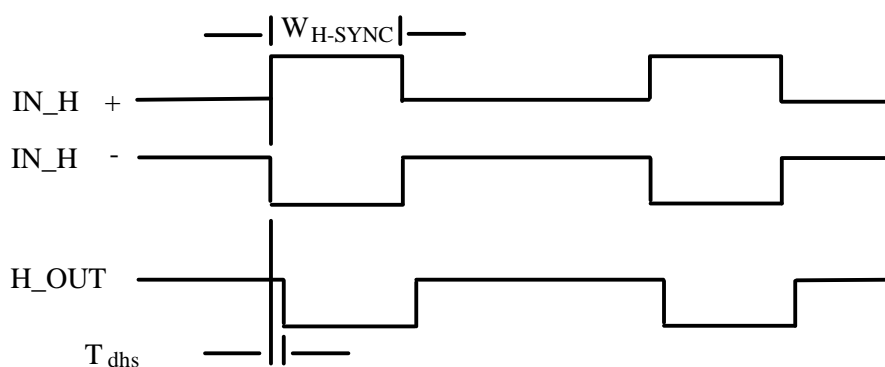
| Name | Function | Structure of Terminal |
|-------------------------|--|-----------------------|
| NEC | NEC 640 x 400, 24.8kHz/ 56.4Hz timing mode | O, open drain |
| 640 x 400 | If IBM VGA 640 x 400 mode, or VESA VGA 640 x 400 mode then active "low" | O, open drain |
| 640 x 480 | If IBM VGA 640 x 480 mode, or VESA VGA 640 x 480 mode then active "low" | O, open drain |
| 800 x 600 | VESA super VGA mode Hsync freq. 35kHz | O, open drain |
| 800 x 600 | European super VGA mode Hsync freq. 37.5kHz | O, open drain |
| 800 x 600 (46.8k,75) | VESA new 75Hz Timing mode | O, open drain |
| 800 x 600 | VESA new super VGA mode Hsync freq. 48kHz | O, open drain |
| 1024x768 (I) | IBM 8514/A interlace mode | O, open drain |
| 1024x768 (NI) | IBM 8514/A non-interlace mode | O, open drain |
| 1024x768 (57k) | XGA 1024x768 mode Hsync freq. 57kHz | O, open drain |
| 1024x768 (60k, 75) | VESA new 75Hz Timing mode | O, open drain |
| F72K | Hsync freq. discrimination control output if > 72 kHz then active low, else high | O, open drain |
| VDD | 5 Volts power supply | |

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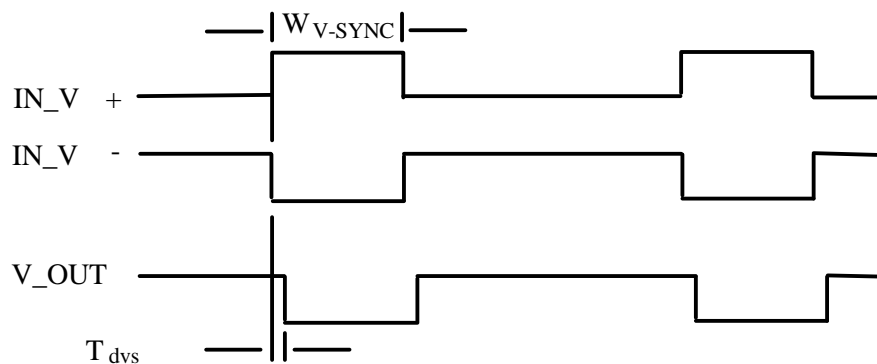
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Time Chart

- **H_{in} - H_{out}**

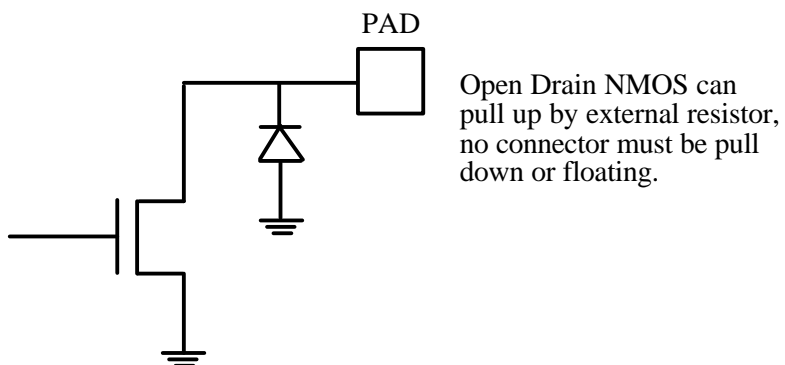


- **V_{in} - V_{out}**

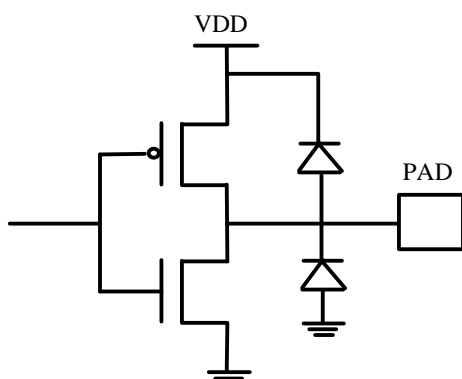


Structure of Terminal

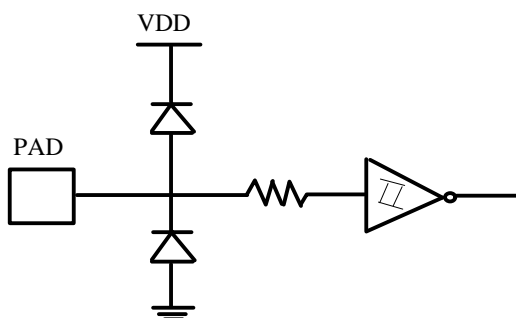
Type 1



Type 2



Type 3



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Block Diagram I

Figure 1-1 WT8043N20P1 Functional Block Diagram

Block Diagram II

Figure 1-2 WT8043N24 Functional Block Diagram

Appication Description

General Description

Figure 1-1 and 1-2 is a simplified functional block diagram of the WT8043. It includes the following functional blocks: sync pulse polarity detector; horizontal and vertical frequency discriminator, mode selector.

The Sync pulse polarity detector accepts separete H and V sync signals with any polarities. It determines their polarities and sends the polarity information to the mode selector for video mode selection. It alos generates -H and -V signals in spite of their input polarities.

The H and V frequency discriminator determines the frequency range of H and V sync signals. The mode selector determines which operating video mode it should be, according to the frequency range and polarity of H and V sync signals. The operating video modes include the standard IBM VGA (640x350, 640x400, 640x480), super VGA (800x600) and IBM8514/A (Inerlaced, Non-interlaced), VESA VGA & SVGA mode, VESA new SVGA mode, XGA (1024x768), and 1280x1024 mode, also including NEC 24kHz and 3 VESA New 75Hz timing modes.

The mode selector also generates output signals that represent the frequency range of H. sync signal. The H sync signal is divided into 6 frequency ranges (3 ranges for WT8043N20) according to Fig. 2, WT8043 has preset the discriminating points between frequency ranges. However, it also offers the flexibility for providing user-defined discriminating points for non-standard video modes.

The digital noise filter is used for rejecting noise on the incoming horizontal and vertical synchronous signals. The input section uses two techniques to improve noise rejec-tion. So the low level noise and the large short duration noise spikes will be rejected. Horizontal synchronous pulse width under 0.56 μ s and vertical synchronous pulse width under 0.56 μ s will be considered as noise.

H/V Frequency Divisions and Video Modes

Figure 2 illustrates the typical frequency ranges of H and V sync signals for display monitors. The operating video modes are determined by the H and V frequencies, and occasionally, by their polarities. The typical video modes of display monitors include the NEC 24k mode, IBM VGA, VESA VGA, European VGA/Super VGA, Apple MAC II, VESA Super VGA, IBM 8514/A, 3 VESA New 75Hz modes, XGA, and 1280x 1024.

WT8043 can determine 18 standard video modes (as shown in Table 1) according to H and V frequencies and polarities. These standard video modes include the IBM VGA, VESA VGA, VESA super VGA and IBM 8514/A. This provides the users with the capability to adjust the screen size for different modes.

WT8043 pre-sets the discriminating points both on H and V frequencies. The discriminating points for H sync are 33KHz, 36.2KHz, 45KHz, 52KHz, 62KHz and 72KHz. These discriminating points will be able to identify various video modes as shown in Fig. 2. WT8043 also provides the flexibility for users to define these discriminating points through mask option.

The tolerance for H sync frequency discrimination is 0.05KHz. For instance, the 33KHz discriminating point will be able to distinguish the H sync frequency that is either "less than or equal to" 32.95KHz, or "greater than or equal to" 33.05KHz. There is an ambiguous region between 32.95KHz and 33.05KHz.

WT8043 has three discriminating points, 64Hz, 73.5Hz and 78Hz, for the V sync signal as shown in Fig.2. The tolerance is 0.01Hz. The discrimination results of V sync frequency are used internally for mode selection.

Based on the package consideration, IBM VGA mode and VESA VGA mode (both have same resolution: 640x480, 640x400, 640x350) are decoded on same open Drain structure output pins (e.g. pin 14 to pin 16 for N20P1 pin type package). In case of these whole 6 modes decoding is needed, the horizontal frequency discrimination pin F33k or F36k must take into consideration. The horizontal frequency of IBM VGA mode is 31.4kHz, and VESA IBM VGA mode is 37.5kHz. Using F33k or F36k pin can clearly identify these two standard modes. The decoding circuit is attached on application section for reference.

Table 1: Graphaic Standard and Frequencies

i I

| Graphic Standard | Resolution | Horizontal | Vertical | Polarities |
|---------------------------|-------------|------------|----------|------------|
| NEC Timing | 640 x 400 | 24.8KHz | 56.4Hz | -, - |
| IBM VGA | 640 x 350 | 31.5KHz | 70Hz | +, - |
| | 640 x 400 | 31.5KHz | 70Hz | -, + |
| | 640 x 480 | 31.5KHz | 60Hz | -, - |
| Mac II | 640 x 480 | 35.0KHz | 67Hz | |
| New 72Hz | 640 x 480 | 38.6KHz | 72Hz | -, + |
| VESA Super VGA | 800 x 600 | 35.2KHz | 56Hz | |
| IBM 8514/A interlaced | 1024 x 768 | 35.5KHz | 86Hz | |
| VESA VGA | 640 x 350 | 37.5KHz | 83Hz | +, - |
| | 640 x 400 | 37.5KHz | 83Hz | -, + |
| | 640 x 480 | 37.5KHz | 72Hz | -, - |
| VESA New 75Hz Timing | 640 x 480 | 37.5KHz | 75Hz | -, - |
| European Super VGA | 800 x 600 | 37.5KHz | 60Hz | |
| VESA New 75Hz Timing | 800 x 600 | 46.8KHz | 75Hz | |
| VESA New Super VGA | 800 x 600 | 48.0KHz | 72Hz | |
| IBM 8514/A Non-interlaced | 1024 x 768 | 48.5KHz | 60Hz | |
| VESA New 1024 x 768 | 1024 x 768 | 56.5KHz | 72Hz | |
| VESA New 75Hz Timing | 1024 x 768 | 60.0KHz | 75Hz | |
| Work Station 1280 x1024 | 1280 x 1024 | 64.0KHz | 60Hz | |

Figure 2: H/V Frequency Division and Video Mode

| | | | | | | | |
|---------|----------------------|-------------------------------|--------------------------------|---------------------------------|-----------------------|-------------------------|------------------------|
| Fv (Hz) | | | 1024X768 (35k, 87) | 640X350 (37k, 84) (+,-) | | | |
| 78 | | | | 640X400 (37k, 84) (-,+) | | | |
| | | | | 640X480 (37k, 75) (-,-) | 832X624 (50k, 70) | 1024X768 (60k, 75) | |
| 73.5 | | | | | 800X600 (47k, 75) | | |
| | | 640X350 (32k, 70) (+,-) | 640X480 (35k, 67) MAC II | 640X480 (37k, 73) (-,-) | 800X600 (48k, 72) | 1024X768 (56.5k, 72) | |
| | | 640X400 (32k, 70) (-,+) | | 640X480 (38.6k, 72) (-,+) | | | |
| 64 | 640X400 (24k, 56) | 640X480 (32k, 60) (-,-) | 800X600 (35k, 56) | 800X600 (38k, 60) | 1024X768 (48k, 60) | | 1280X1024 (64k, 60) |
| 30 | | | | | | | |
| | 11 | 28 | 33 | 36.2 | 45 | 52 | 62 Fh(KHz) |

Table 2: IBM VGA/ VESA VGA Decoding Table

| Mode | | PIN | 640 x 480 | 640 x 400 | 640 x 350 |
|----------|--|-----------|-----------|-----------|-----------|
| IBM VGA | | 640 x 480 | 0 | 1 | 1 |
| | | 640 x 400 | 1 | 0 | 1 |
| | | 640 x 350 | 1 | 1 | 0 |
| VESA VGA | | 640 x 480 | 0 | 1 | 1 |
| | | 640 x 400 | 1 | 0 | 1 |
| | | 640 x 350 | 1 | 1 | 0 |

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Horizontal Frequency Discriminator

There are 3 horizontal frequency discriminator pins on 20 pin type package: 36.2kHz, 45kHz, 52kHz (for N20P1), 33kHz, 36.2kHz, 45kHz (for N20P4); 2 frequency discriminator pins on 16 pin type package: 33kHz, 36.2kHz and 6 frequency discriminator pins on 24 pin type package: 33kHz, 36.2kHz, 45kHz, 52kHz, 62kHz and 72kHz. Please refer to table 3 for the logical truth table of these pins. These frequency discriminator pins can pull up to +12V through a resistor, sink current to the open drain structure must keep under 6mA (ref. P4 Electrical Characteristics). These frequency discriminator pins output can be used for CS Capacitor Control directly as well as other application.

Table 3: Truth table of Frequency discriminator

| Signal Hsync | F33K | F36.2K | F45K | F52K | F62K | F72K |
|------------------|------|--------|------|------|------|------|
| Hs < 33k | 1 | 1 | 1 | 1 | 1 | 1 |
| 36.2k > Hs > 33k | 0 | 1 | 1 | 1 | 1 | 1 |
| 45k > Hs > 36.2k | 0 | 0 | 1 | 1 | 1 | 1 |
| 52k > Hs > 45k | 0 | 0 | 0 | 1 | 1 | 1 |
| 62k > Hs > 52k | 0 | 0 | 0 | 0 | 1 | 1 |
| 72k > Hs > 62k | 0 | 0 | 0 | 0 | 0 | 1 |
| Hs > 72k | 0 | 0 | 0 | 0 | 0 | 0 |

SYNC Output State Description

Both H_out / V_out duplicate Hsin/Vsin in the same frequency and pulse width, but are fixed at negative polarity. And H_out/ V_out have their own cut-off frequency: 15kHz for H_Sync and 30Hz for V_Sync. While the frequency of input signal is less than the cut-off frequency, the output will keep in low state. Please refer to the Table 4.

Table 4:

| Hsin | Vsin | H_out | V_out |
|--------|-------|------------------------|------------------------|
| >15kHz | >30Hz | Negative polarity Hsin | Negative polarity Vsin |
| >15kHz | <30Hz | Negative polarity Hsin | Low state |
| <15kHz | >30Hz | Low state | Negative polarity Vsin |
| <15kHz | <30Hz | Low state | Low state |

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Application Circuit I

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Application Circuit II

Physical Dimension

| | A | B | C | D | E | F | G |
|------------|------|-----|-----|-----|-----|-----|-----|
| 16L | 754 | 250 | 130 | 100 | 130 | 355 | 300 |
| 20L | 1024 | 250 | 130 | 100 | 130 | 355 | 300 |
| 24L skinny | 1250 | 260 | 130 | 100 | 130 | 355 | 300 |

* Dimension in mil

* 1mm = 39.37 mil